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THE EARTH WE INHABIT

DRAYSON.



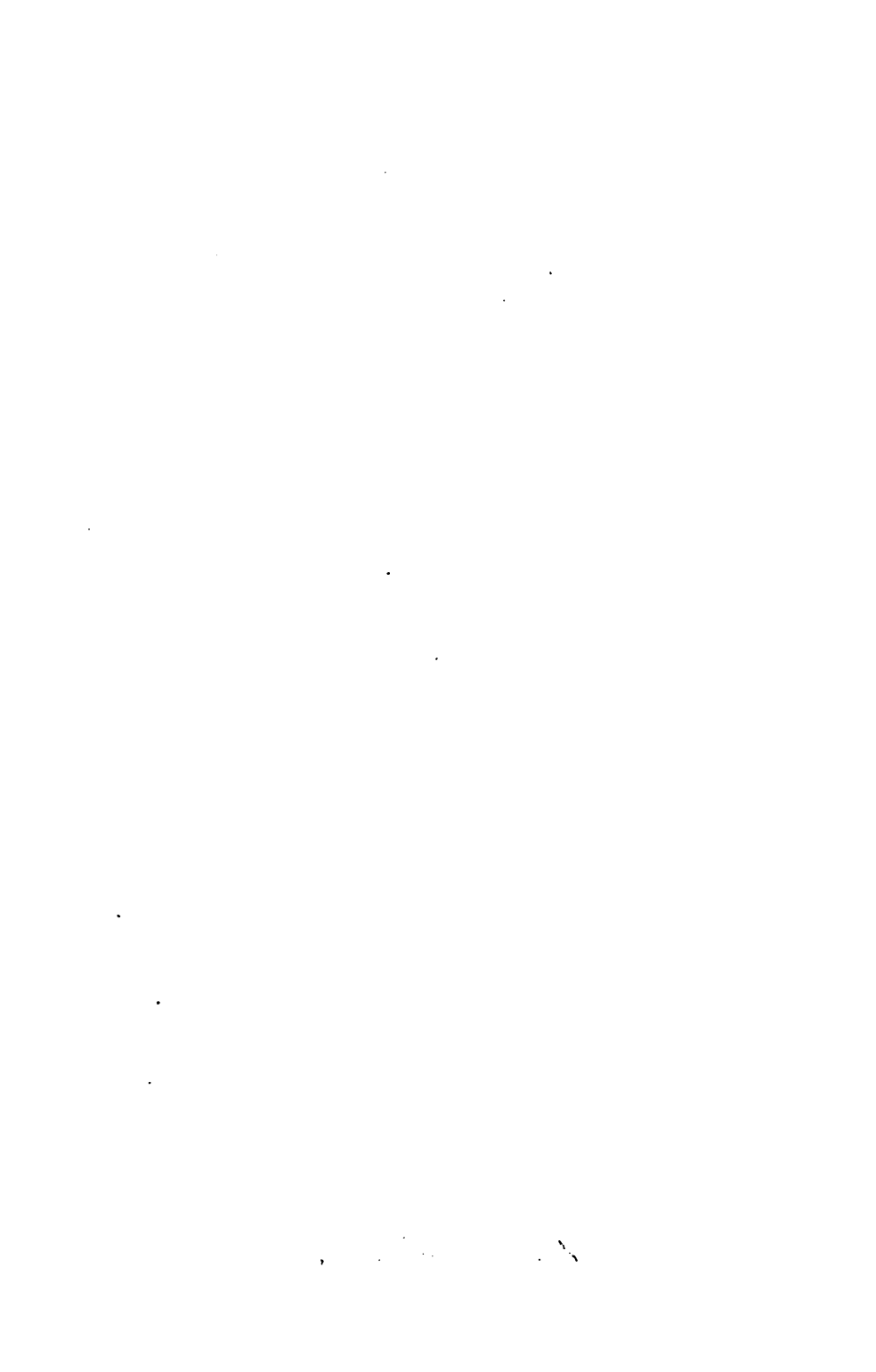


THE

EARTH WE INHABIT:

ITS PAST, PRESENT, AND PROBABLE

FUTURE.



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BY

CAPTAIN ALFRED W. DRAYSON,

Royal Artillery,

AUTHOR OF "SPORTING SCENES IN SOUTH AFRICA," &c.

"As yet we are in the infancy of our knowledge. What we have done is but a speck compared to what remains to be done. For what is there that we really know! We are too apt to speak as if we had penetrated into the sanctuary of Truth, and raised the veil of the goddess, when in fact we are still standing, coward-like, trembling before the vestibule, and not daring from very fear to cross the threshold of the temple."—*A Discourse by* HENRY THOMAS BUCKLE.

LONDON:

A. W. BENNETT, 5, BISHOPSGATE WITHOUT.

EDINBURGH: JOHN MENZIES.

1859.

[The Author reserves the right of translating this book.]

184. b. 16.



INTRODUCTORY CHAPTER.

DURING several years experience in practical Surveying, certain inconsistencies with regard to measurement of distances and areas, were perpetually presenting themselves. The study of astronomy enabled me to investigate closely the observations connected with Geodesy, and to compare these observations with the recorded measurements. I could not then avoid noticing, that whilst the most perfect accuracy was supposed to have been attained in astronomy and surveying, still, when the results obtained by the two sciences were compared, the most alarming differences were almost invariably found to exist. The more perfect the instruments, and the more skilful the operators, the more surely was a discordance found.

Upon examining the records of former measured distances, it appeared that the later operations showed

this same distance to contain more feet and inches than formerly. My first idea was, that the measuring metals had contracted, but the great care which each operator had taken to guard against such a contingency, very shortly induced me to search for another cause. After many months, it was suggested to me, that possibly the earth was expanding, instead of the metals contracting ; but no sooner did this idea present itself, than it was almost instantly rejected, for I hastily concluded that such a fact could not have escaped observation had it existed. I have always been disinclined to reject any suggestion, however novel, until I had closely examined its various phases. I therefore proceeded to reason upon the possibility of the growth of the Earth.

In itself this growth did not seem to be an impossibility, for all nature appeared to be on the increase. It was true, that science had laid down definite laws for organic and inorganic matter, but this science was dependent upon observation, and if the growth of the earth had escaped observation, then the conclusions of science might be fallacious, or in other words, the definition of the word "inorganic" might be incorrect.

The highest learning of the day has sometimes been wrong, for it was the most learned who ridiculed the miracles of our Saviour; it was the scientific who scorned the idea of satellites to Jupiter, of a Continent of America, of the sphericity of the earth, of steam; and many other matters within the compass of our own memory. Therefore it appeared not *impossible* that the earth might be increasing in size, although the fact was unknown to the scientific.

But then came the natural idea, that every person would and must discover this growth. Here was the dangerous point; for hasty conclusions are too often wrong; and it was at this turning that the whole problem was nearly being resigned.

The first step was to examine how the growth could be discovered, supposing that it were still going on. To measure a certain distance, wait a few years, and re-measure it, would be of course the first proceeding. But to do this, it would be necessary to wait some years, and the difficulty of maintaining during that time a certain standard, at once suggested itself to me.

The standard for common measurement is usually

two marks on the ground ; if, therefore, the earth increase in size, this standard would increase in like manner, and the fact would remain concealed. The examination of this test from a professional point of view, at length convinced me that, instead of the growth of the earth being a problem of simple solution, it must be in fact one of the greatest difficulty, and experiments extending through at least twenty years, and aided by most perfect instruments, would be required to disprove the fact, if it existed.

But other individuals who had lived before, and measured before, might be able to help us ; and it would be very easy to re-measure their distances, so that if any increase were then found, the question would be decided. The records of measurements from 200 years B.C., down to the present time, were then examined, with what result will be seen in the first chapter. The past and present records of astronomy were next searched, for the purpose of endeavouring to disprove rather than to prove this continual increase ; but, at every point I was defeated. Lest I should commit the common error of supposing that I had discovered that which was

already known, I proceeded to examine every book which I could procure, and which treated of astronomy and geodesy. Upwards of eighty volumes were then read, and the theories and results of each compared; books dated 130 years ago were found to contain much the same ideas as those of the most recent dates. Observations have lately been made with the greatest accuracy, and facts of the greatest importance have been ascertained, but the *causes* of these facts either remain unexplained, or are described somewhat obscurely—and in the same manner as they were 100 years ago.

Every well ascertained fact tended to show that the Earth was increasing in size, and at the same time was also increasing its orbit. When at length the accumulation of evidence was so great that I considered the growth almost a certainty,—I then searched the records of geological observations, and of all other matters tending to prove or to disprove my conclusion; these additional proofs will be found in the following pages.

One argument, which might be considered very powerful by those unacquainted with the details of

astronomical observations, is, that if the growth of the earth and the increase of its orbit were two facts unknown to astronomers, how is it that eclipses are foretold to the minute? In answer, it must be borne in mind, that all calculations depend first upon observation; and the movements of the Sun and Moon have been accurately noticed during many years. It is known from observation, that eclipses now take place earlier than formerly; but, to account for the *cause* of this alteration, a theory has to be invented. Astronomy, if divested of the intricacies that science weaves about it, is in itself a simple and fascinating occupation. An eclipse could be calculated by any individual after two months study, provided he were acquainted with the common rules of algebra and trigonometry.

The highest attainments of mathematics, when brought to bear upon astronomy, rest entirely for their accuracy upon observation—and if the observer commit an error, the most conclusive theories yet built thereon, are valueless. Without, therefore, attempting to cast discredit upon the accuracy of the observations of the great astronomers, past and pre-

sent, I will merely remark, that the state of the atmosphere, of the telescope, of the observer, of the adjustment of the instruments, and of many other matters, all tend to produce errors. And also, that every observer does not obtain like results, may be shown by one example. It was remarked by Dr. Brinkley, D.D., F.R.S., &c., that the diameter of a planet can be most accurately ascertained, as it is not affected by the planet's distance. If now we take Jupiter, one of the largest, we find his diameter, according to different authorities, as follows—

Professor Baily—10·86 times earth's diameter=
86,054 miles.

Sir J. W. Herschel—

Page 339 Outlines of Astronomy—	87,000 Miles.
361	91,128 „
695	90,734 „

Loomis' Practical Astronomy—

Page 462	92,164 „
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a difference of upwards of 6,000 miles, between two observations.

It appears a very general error, to consider mathematics final. In astronomy and geodesy particularly, it is necessary to use mathematical formulæ with

caution, for it is much more easy to arrive at solutions by theory than by practice ; but, if the first observations, which can be the result of nothing but practice, be in the slightest degree in error, our mathematical theories built thereon, rest upon sand-hills.

We have already seen that the diameter of a planet is estimated somewhat differently by different observers. Let us now examine another problem, one upon which the whole organisation of the solar system, and of the permanent length of the days, distance of planets, their velocity, and many other important matters, may be said to rest.

This second problem is the distance of the earth from the sun. When we refer to this elementary matter, we shall naturally raise at our expense a smile from the profound theorist, who deigns not to turn his attention to so simple a question. But, as we find that the sun was said to be at a distance of 95,000,000 miles from the earth in 1760, and as it is necessary, before we take observations for ascertaining the sun's distance, to know accurately the latitude and longitude of our places of observation, we naturally

examine, first, whether the latitudes and longitudes of even great observatories were correctly known at that period.

What is called the horizontal parallax of the sun (from which, in addition to the transits of Venus, the sun's distance is obtained) is a very minute quantity ; but so accurate were the observations in those days, that two observers, who differed the one-fifth part of a second in their results, were actually dissatisfied with themselves. It must be noted, however, that if from two observatories, observations be taken, and if the latitude of these observatories be one second in error, then the observations *must* be also one second in error, and they *may* be two seconds. Now, if we take any two observatories—say Edinburgh to the far north, and Cape Town to the south—we find that their latitude has, within the last thirty years, been found to be sixty-two seconds* in error ; whilst even Greenwich itself has been found to be in its wrong place by three seconds.

* Cape Town Observatory, lat. $33^{\circ} 55' 42''$, by Baily, 1827.

Do. „ $33^{\circ} 56' 3''$, Naut. Almk. 1858.

Edinburgh „ „ $55^{\circ} 56' 42''$, by Baily, 1827.

Do. „ „ $55^{\circ} 57' 23''$, Naut. Almk. 1858.

Now, if Edinburgh and Cape Town were the two observatories from which the parallax of the sun, and hence its distance, was determined, it would follow that, instead of 95,000,000 being our correct distance from the sun, we might be only 1,000,000 miles. And, whilst the two learned mathematicians differed from each other the one-fifth part of a second, and were dissatisfied with such a discrepancy, they were actually admitting errors in their calculations of more than three hundred times that amount. And, in addition to these, there are also considerable alterations in the longitudes. This is another example given to prove that, however grand theoretical problems may be, they are utterly worthless unless built upon the soundest and most perfect observations ; and observations, from being made by man, with even the most perfect instruments, must possess certain unavoidable errors. When we compare the records of different celebrated observers, we cannot fail to discover, that the minute accuracy which is supposed to have been obtained, is theoretical, and not practical.

This being the case, there is less courage needed to assert that a great fact has been gradually going

on since the Creation, but has hitherto escaped the observation of astronomers and others. And we will now proceed to examine the evidence upon which we have concluded that our earth is increasing in size and is extending its orbit.

CHAPTER I.

MEASURED DISTANCES.

EVERY person who has at any time been called upon to measure accurately any long distance, must be aware that in practice the work is one of great difficulty. Not only has the individual to contend against the irregularities of ground, the obstacles in his path, and the expansion and contraction of his measuring instrument, but that most common of all errors, "personal error," is perhaps the most difficult to avoid.

For surveying, or astronomical works, the accurate measurement of a base line is of the first importance. All the other part of the performance is dependent upon this one first step; and, therefore, the accuracy of the base line calls for all the skill and attention of the operator. Those who have ever undertaken this work need not be reminded of its difficulty. I refer now not to glaring mistakes, but to the error of per-

haps four or five inches in a distance of two miles, an error which would in practice be disregarded, the measurement being looked upon as satisfactory.

For the survey of Ireland, a base was measured with great skill, by means of some compensation bars invented by Colonel Colby, of the Engineers ; but so slowly did the work progress, owing to the caution which was exercised, that only 250 feet per day were passed over. From this base, the other stations were laid down, and the survey completed.

To measure what is called an arc of the meridian, to determine the size of the earth, a base line is also necessary, and even greater accuracy is required ; but, with all the care which each manipulator uses, there still exist extraordinary discrepancies. Many skilful and scientific men have devoted their time and labour to the adjustment of these errors, but no very satisfactory conclusion has yet been arrived at.

Professor Playfair remarks, that “the anomalies which have occurred in the measure of degrees, and of which the appearances seem to increase in proportion as greater pains are taken to avoid inaccuracy, have naturally drawn the attention of mathematicians,

and the question, what part of them is to be ascribed to error, and what to irregularity in the structure of the globe, has come, of course, to be considered." Let us, however, examine the records of former measurements, and note to what direction these anomalies tend.

It is only within the last three hundred years that any measurements have been made of portions of the earth's surface, which can be looked upon as very trustworthy; and it may be safely asserted that, scarcely a hundred years ago, geodesy was so much in its infancy, that the measurements since that period are those only which can be taken as certain evidence, when examining the accurate distances of towns, or the form of the earth.

Perhaps the most ancient measurements on record are those made by Eratosthenes, 230 B.C., and by Ptolemy, A.D. 137. The latter was evidently a close observer, and as he remarked that eclipses were seen at different (local) times at different parts of the earth, and also noticed the apparent change in the position of the circumpolar stars, when an observer moved north or south, he thence proceeded

to calculate the size of the earth, and he adopted 500 stadia as the length of one degree.

An atlas, admirably correct in all those particulars which an individual can test at the present day, was published in France about 1760, and states, "that the stadium of Ptolemy was 113 toises, 5 pi. 5 po.," therefore, in round numbers, Ptolemy's degree was 56,900 toises. A degree is now said to be 57,060 toises, *or 160 toises longer.*

The next measurement appears to have been made by a Caliph Abdallah Almamoran, who concluded that a degree was $56\frac{2}{3}$ miles of 4000 cubits. But as the length of a cubit is not correctly known, this measurement becomes nearly valueless for reference.

A Parisian of the name of Fennel next measures a distance near Paris, in 1528, and he finds a degree 56,746 toises, or a shorter distance than that shown by Ptolemy's estimation, but still 314 toises less than is shown by the present calculations, the late measurements of the same distance being longer.

These measurements were, probably, roughly made,

and no very great dependence can be placed upon them; still, they appear to show a vast difference between former results and those to which more modern science has arrived.

In 1617, Snell measured a small base of about a mile in length, and although this distance was very short, still, as two bases of verification were used, and a system of triangulation was adopted, and, also, a careful comparison of standards was made, this work may be considered nearly as correct as more modern operations, and is the first upon which any dependence can be placed. But Snell finds a degree $= 55,100$ toises. The latitudes were re-calculated in 1729, or about 114 years afterwards, and $1^\circ = 57,033$ toises, was the result; or a difference of nearly 2000 toises, the latter measurement being *the longer*.

In 1669, Picard measured a base line, and employed great care in the manipulation; his base of verification was 3902 toises in length, and he found $1^\circ = 57,060$. Maupertius and others repeated the operations in 1729, and found $1^\circ = 57,183$ toises, or 123

toises longer. Inconsistent as these measurements were, they were those which enabled Newton to confirm his theory that the earth was an ellipsoid.

Later measurements appear to show less disagreement, but still, the most perfect instruments fail to adjust these discrepancies, and the error appears to be always, that the last measurement is the greater.

We will now refer to more recent measurements in different parts of the world.

The following, amongst many others, are some of the discrepancies. We quote first from a French book of 1760.

An arc of the meridian was measured in 1752, in France, and this distance was found to be 56,925 toises. Another individual measures in the same latitude, and finds the arc 57,422. Again, in 1739, an arc was measured between Paris and Amiens, and this was found to be 57,138 toises in place of 57,060 toises, which length had always before been attributed to the same distance. The arc 56,925 was again measured by the French some years afterwards, and it was then found to be 56,979 toises.

How was it that the arc between Paris and Amiens

was found to be *longer* by the second measurement than by the first, by 78 toises? The arc 56,925 was found, also, *longer* by the second measurement by 54 toises.

In 1801, General Mudge and party find a degree of latitude in $52^{\circ} 2'$ north latitude to be 121,640 yards, and, on the authority of Sir J. Herschel, page 131, "Outlines of Astronomy," this degree of latitude is now 121,650 yards, or *thirty feet longer*.

It is now necessary that we should proceed with the greatest care, for the investigation becomes important. The best evidences must be examined, and some conclusion must then surely be arrived at.

Perhaps the individual whose name is most intimately connected with the accurate measurements of base lines, is the late Major General Colby, of the Royal Engineers. His memoir, lately published in the professional papers of the corps of Royal Engineers, is, probably, the best existing authority on base lines, and the other measurements of different parts of the earth's surface. From vol. III., pages 10 to 30, I will make free extracts: "A base on Salisbury Plain was measured in 1794 with steel

chains, and was found to be 36574·4 feet long, and the length, as obtained by triangulation from the Hounslow Heath base, being 36574·3, exhibited, therefore, a difference of little more than an inch in a length of nearly seven miles.”* “The length of the degree at the middle point between Dunmore and Burleigh Moor, is determined to be 60823·2 in the latitude $52^{\circ} 35' 45''$, whereas, as observed by Col. Mudge, the length of the degree by the observations and calculations of previous years, has been determined to be 60820· fathoms, or only four feet difference;†” *but the four feet was an increase.*

An extraordinary difference is reported, at page 21, to have existed between Inghirami's observations at Florence, and the different measurements; but as the case appears to be obscure, the evidence must count for nothing. In 1817, Captain Colby measured a base on Belhelvie Sands. “The measurement of this base occupied from May 5th to June 6th, and Ramsden's steel chain was again the instrument used. Its length, when compared with the unit Ordnance standard bar O, is found to be 26516·66

* Page 10.

† Page 15.

feet, and the length as deduced (in 1827) from the Lough Foyle base, is 26518·99 feet, showing a difference of about $2\frac{1}{3}$ feet *longer* in five miles.

“Hounslow Heath base, with glass rods, when reduced to the Ordnance Standard, 1784 . . . 27405·06
 Ditto, with steel chains, 1791 27405·38
 Deduced by computation from Lough Foyle
 base, 1827 27405·83.”

This base does not appear to have increased so much as the others which will now be mentioned.

“Salisbury Plain, by steel chains, 1794 . . . 36575·64
 Computed from Lough Foyle base, 1827 . . . 36577·34
 By Colby's compensation bars, 1849 . . . 36577·95

“Misterton Carr, steel chains, 1801 . . . 26342·72
 Computed from Lough Foyle, 1827 . . . 26350·76.

“Rhyddlan Marsh, steel chains, 1806 . . . 24515·2
 Computed from Lough Foyle, 1827 . . . 24518·2.”*

These are the most correct measurements that, perhaps, have ever been made on the face of the earth. Men of the greatest skill have been employed; instruments of the most perfect construction have been used; every precaution has been adopted to avoid error; and all that science could do has been done—

* Page 27, vol. III., “Professional Papers.” New Series.

but still, the later measurements do not agree with the earlier, but are *greater* in every case. Some bases, as that at Hounslow Heath, are but a little increased, but this base *has* still increased, whilst the others are longer by several feet.

Captain Yolland, R.E., whose works on Geodesy and Astronomy are so well known, states that the iron ten-feet standard bar O, is no doubt too short as compared with the standard used by Major General Roy, Mudge, and Colby. Upon what evidence Captain Yolland came to this conclusion, we cannot positively state, but any practical surveyor, who found that all his areas and distances were greater than those of the able men who had gone before him, would naturally conclude that his present standard must be shorter than was theirs.

After a very extensive search, it has been found impossible to obtain a fair comparison of the amount of acreage in the whole or part of England, at different periods. But, upon comparing an estimate made by a Mr. Rickman, in 1800, with present surveys, it appears that there are, according to the most recent surveys, upwards of 800,000 acres more

at the present time than was then considered the correct amount; and it is considered, that when the present Ordnance surveys are completed, there will again appear an increase of nearly half a million acres in the total area of England and Wales.*

* See Report on '51 Census, by Col. R. K. Dawson, R.E., C.B.

CHAPTER II.

OBJECTIONS.

SURELY if the earth were growing, the railways would be broken up. Let us reason upon this. Each sleeper is laid in the ground, and the iron rail is fixed upon this sleeper. Take the rails as averaging each 20 feet in length, the increase of growth during a year being, say, $\frac{3}{4}$ of an inch per mile; each rail would separate from its neighbour about the twenty-thousandth part of an inch, or not quite the tenth part of a hairs' breadth;—let any individual try to measure this space. But in several years this distance would amount to something more palpable. Let us take twenty years; then each rail would have separated from its neighbour two hairs' breadth, supposing that the continued traffic of heavy trains did not cause the rails to expand; when, if this happened, even this

distance would not be perceived. Again, it will be concluded, that such large buildings as St. Paul's Cathedral, Westminster Abbey, St. Peter's at Rome, would soon fall to the ground; but our figures tell us that even 1 inch per mile would merely cause a separation of the extreme walls of about 15 inches in 300 years, and this 15 inches would be distributed amongst the whole of the bricks or stones forming the building.

This calculation, moreover, does not suppose that the solid foundations upon which such buildings stand, would prevent that part of the earth from increasing so rapidly as other parts, and yet such a result would most probably happen. Nearly every individual must have remarked that very old buildings and walls do, in nearly every case, become cracked, and appear as though separating one part from the other. This appearance is usually attributed to a sinking of the foundation, but as the walls or buildings rarely show any signs of sinking, but merely of cracking, the assigned cause scarcely accounts for the effects.

But is there nothing to disprove the fact—surely

the milestones cannot be in their right places? The milestones in many parts of England have been moved within the last twenty years.

But here again we must proceed cautiously, for standard distances are the most difficult to adjust, as they are dependent upon standard measures, and although we may say—a mile is 1760 yards, we may then ask what is a yard; and we *must* at length have to refer to a certain unchangeable standard. The French metre is a decimal part of the earth's circumference; if, therefore, the earth be increasing, the metre from century to century would have to be altered; a very trifling distance it is true, perhaps only the thousandth part of an inch, but still it would have to be altered. With us the standard yard is yet more difficult to decide upon, and when the standard was destroyed in the fire at the Royal Exchange, it was found a difficult matter to again accurately determine what distance a yard should be. There has been, however, a comparison between French and English standards for many years, and the French toise is now said to be, to an English foot, in

the ratio of 1 to 6·39459252. If therefore the French toise or metre became longer, it would be necessary to make the English foot longer. Consequently, if we measured between two stations, we should find the distance which separated them the same, although they might have grown further from one another.

Upon reference to a French work, we find that 826 French toises = 5281·93 English feet = 1 English mile; this is dated 1760, and it therefore appears by this, that the English foot has been made longer, for it now requires but 5280 feet to make a mile. It then appears that our forefathers, as well as ourselves, adopted every means (unconsciously) of preventing the increase of the earth from being discovered. If during the next ten thousand years our earth grew to twice its present size, the fact would not be discovered by measurements, provided the standard employed (yard or metre) were gradually elongated during that period, about an inch, or perhaps an inch and a half, the ratio of the surface of spheres being $4\pi r^2$; this fact will be at once evident, for the diameter need.

not increase very much, to allow the earth to have double the area which she now possesses. But as this earth is small to measure upon, and the instruments with which measurements are made are so faulty, let us therefore examine the heavens, and so bring the accurate tests of astronomy to bear upon the subject ; here we shall surely be enabled to disprove the alleged fact.

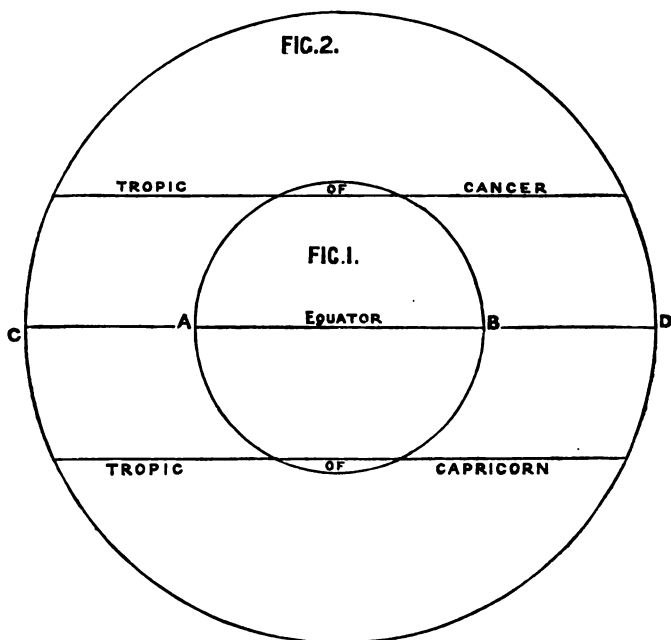
But in what way ? By ascertaining latitude and longitude, to be sure.

Not then, certainly ; for as latitude and longitude are both measured by degrees, the former from the equator, the latter from a certain meridian, and as the earth is a sphere, and every circle, large or small, has but 360° , perhaps the most difficult means of discovering the growth of the earth would be by determining the latitude and longitude. A spot on the earth's surface would be in the same latitude, and have the same longitude, were the globe suddenly to swell to twice its present size, and the person who would probably be the most difficult to convince of this great fact, would be the astronomer, who saw and observed nothing but latitude and longitude.

There must, surely, be some means of disproving the notion of the growth of the earth? Yes, there is a very simple method. Proceed to the Tropic of Cancer, and, on the 21st of June, when the sun has its greatest north declination, it would then be directly over the observer's head, or, as astronomers say, in the zenith. Where this occurs, drive a peg into the ground where you are standing. After two or three years have elapsed, proceed again to the spot, and the peg will then, if the earth grows, have moved more north, and further from the equator, other circumstances remaining the same. The sun, on the 21st June, would not then be in the zenith of the peg, but would be in the zenith of the old position of the peg; and, therefore, the sun would have appeared to have decreased its declination. Such a trial would at once prove or disprove the growth of the earth. This apparent change in the position of the sun has been going on for the last two thousand years, as the following records prove:—

CHAPTER III.

If the growth has been going on for perhaps forty thousand years ; if the great Creator of the universe has merely carried out his universal law, and has said even to the globe on which we stand, "Increase," then perhaps it was once very small, perhaps as small as fig 1., whilst the present earth is the size of the larger circle. But, if this were the case, the tropics



would then extend to the north and south poles, the orbit increasing in proportion. And is there any proof that this was the case? Let us quote :—

“There was, however, another phenomenon to marvel at. Though the ancients may not have been aware that a diminution of the obliquity of the ecliptic is going on, yet the aforesaid Egyptian wizards told Herodotus that the ecliptic was once perpendicular to the equator, or, in other words, was at the poles.”*

“There were also plants resembling the horse-tail tribe, of gigantic size; others like the tropical club mosses; an aquatic plant of an extinct family was very abundant, besides many others to which we have nothing analogous. Forest trees of great magnitude, of the pine and fir tribes, flourished at that period. The remains of an extinct *Araucaria*, one of the largest of the pine family, have been found in the British coal fields; the existing species now grow in very warm countries.”

“Numerous species of extinct animals, that lived during the earliest, or Eocene period, have been found in various parts of the world, especially in the Paris

* Smyth's Celestial Cycle.

basin, of the order of Pachydermata. This is most extraordinary, as existing animals most similar to these—the tapirs, for instance—are confined to the torrid zone.”*

* * * * *

“The remains of one or more land plants, in a very imperfect state, have been found in the Silurian rocks of North America, which shows that there had been land, with vegetation, at that early period. The type of these plants, as well as the size of the shells and the quantity of the coral, indicate that a uniformly warm temperature had then prevailed over the globe.”

“The question as to fossil remains is, certainly, one of the deepest interest to geologists and enquirers, but it may be at once stated that exact astronomy will render them but little aid. To account for the marvellous profusion of tropical animals, fruit, trees, and seeds, which are often picked up in hyperborean realms, some theorists have conjured up a diminution of the terrestrial temperature; but Laplace drew a conclusion, which is confirmed by the lunar theory, that the length of a day has not been lessened by the

* Somerville's Physical Geography.

200th part of a centesimal second since the time of Hipparchus."* Now it needs nothing more than that it be granted that the earth has increased in growth, and the mystery of fossil remains at the North Pole, of tropical seeds, plants &c., being found in northern regions, at once vanishes.

To account for these strange and apparently unexplained circumstances, not even a wild theory has been invented, although, to account for some of the other mentioned phenomena, the most vague formulæ and ideas have been put forward—formulæ which observations even now contradict, and which, as we advance year by year to more perfect systems of mathematical and instrumental accuracy, we shall find must be discarded. We refer not now to well proved facts of science, but to those unsatisfactory explanations of certain curious changes in stars, which, although professing to show the "*cause* of these changes," still leave the cause more obscure than ever.

But if the earth has increased in size, it is natural to conclude that countries which now are separated

* Smyth's Celestial Cycle.

by seas, once joined each other, and there should be some similarity in the geological strata of these continents. At pages 58-59 of "Physical Geography" by Mrs. Somerville, there is the following:—

"It seems to bear upon the subject, that parallel mountain chains are similar in geological age, even when separated by seas, for the mountains of Sweden and Finland are of the same structure, though the Gulf of Bothnia is between them; those of Cornwall and Brittany and the north-west of Spain are similar; the Atlas and the Spanish mountains, the chains in California and those on the adjacent coast of America, and lastly those of New Guinea and the north-east of Australia, furnish examples.

"Continents and mountain chains are often interrupted by posterior geological changes, such as clefts and cavities formed by erosion, as evidently appears from the correspondence of the strata. The chalk cliffs on the opposite sides of the British channel show that Britian once formed part of the continent; the formation of the Orkney Islands and Ireland is the same with that of the Highlands of Scotland; the formation is the same on each side of the Straits

of Gibraltar; that of Turkey in Europe passes into Asia Minor; the Crimea into the Caucasus; a volcanic region bounds the Straits of Babelmandel; and Behring's Straits divide the ancient strata of a similar age."

But how would these changes be effected? By a rapid convulsion, or by a gradual expansion? Which of these, let us ask, is most like nature's usual proceedings? Do we find trees or shrubs, men or animals, increasing by convulsions? Does not the steady, slow, and gradual increase of the earth appear the far more probable mode? Our own history indeed tells us, that the Isle of Wight once joined the coast of Hampshire. Again, quoting from Mrs. Somerville's "Physical Geography," we find that, "Mr. Hopkins, of Cambridge has taken a purely mathematical view of the subject and has proved that, when an internal expansive force acts upwards upon a single point in the earth's crust, the splits or cracks must all diverge from that point like radii in a circle, which is exactly the case in many volcanic districts; that when the expansive force acts uniformly from below, upon a wide surface or area, it tends to stretch the surface, so that it

would split or crack where the tension is greatest, that is, either in the direction of the length or breadth, and if the area yields in more places than one, he found that the fissures would necessarily be parallel to one another, which agrees with the law of arrangement of veins of mines."

If the earth be growing, it can only be accounted for by an expansive force acting from the interior; the above remarks are therefore, as far as they go, quite true, and merely corroborate known facts.

CHAPTER IV.

ANALOGY AND SCRIPTURE EVIDENCE.

If it be considered possible that our earth, the planet which has been inhabited by the human race for many hundreds of years, be increasing in size, it may be possible that at the end of some hundreds of thousands of years, we might become as large as that glorious planet Jupiter ; and what might happen then ? The decrease in the obliquity of the ecliptic, which has been gradually going on from year to year, would perhaps then become as acute as that of Jupiter. To compare results, a circle 7924 feet in diameter was constructed, and another 89000 in diameter, to show what the earth might become. A line was drawn parallel to the equator from the termination of the ecliptic ; this line meeting the larger circle, showed that according to a rough scale, the inclination of our ecliptic would then be as nearly as possible 2° . Upon referring to an

able book upon astronomy, we find Jupiter's orbit is inclined to the plane of the ecliptic at an angle of about $1^{\circ} 18'$.

But now we must consider another circumstance. Jupiter is much further from the sun than we are, and if we were to attain to the size of Jupiter, we ought to be moving further from the sun; consequently, it might be concluded by some one that we must be getting colder; but this idea could only originate from a belief in that most vulgar of errors, viz., that the sun is a fiery body, and gives out heat as does a fire. If this were the case, the nearer we approached the sun, the warmer we should become. Let us endeavour to test the truth of this opinion. If we ascend a mountain, when the sun is directly over our own heads, do we first experience heat or cold? Do we not first find snow? To refer to this error may perhaps be unnecessary, but the idea is so universal that "the further a planet be from the sun, the colder its climate *must* be," that perhaps the following suggestion may not be out of place.

Pass a current of electricity through a copper wire, and there will be no apparent change of tem-

perature, because the copper is not an opposing medium; pass the same amount of electricity through a platina wire, and great heat will be evolved, the platina wire being an opposing medium. If the sun's heat be of an electrical nature, and such is even now considered probable, it would be but necessary to give the planet Saturn a more dense atmosphere than that possessed by our earth, and the hottest summer day in the tropics of Africa might be more cool than a winter's day in the distant Saturn.

So many conditions are involved, and heat depends so mainly upon these conditions, that to assume that distant planets are possessed of only a certain amount of heat and light, because they happen to be a few millions of miles further from the sun than our own planet, is mere reckless reasoning.

Now let us return to the earth's orbit, and carry out this same reasoning by analogy, but with more caution than appears to have been adopted with the light and heat theories. There may not be any very considerable error with regard to the size of the planet Mercury, which planet is said to be about 3140 miles in diameter, and to perform his sidereal revo-

lution in about 88 days ; that is, the year is 88 days in length, so that we may adopt this datum with tolerable security. But if the diagram which we constructed be correct, our planet must, at the period referred to as that at which the mammoths roamed over the polar regions, have been even smaller than Mercury, and consequently the year then might have been probably only 30 or 40 days in length, the earth then performing its revolution in that period of time. Is there any evidence to confirm this idea ? We will now venture to tread on sacred ground, but in so doing, we disclaim any intention of seeking thereon a sanctuary, for the purpose of avoiding the criticism with which every new assertion ought to be examined. But with all reverence we will state that the Bible will be referred to, in order that certain passages therein, which may have appeared incomprehensible to many readers, may be cited in confirmation of the probabilities of the growth of the earth.

Let us suppose that, in the earliest ages, the earth performed its revolution in thirty-six days ; the year then would be about one-tenth of its present duration. The fifth chapter of the first book of Genesis tells us :

“All the days that Adam lived were nine hundred and thirty years, and he died.” Now, without presuming to disallow that a miracle might have been enacted in favour of Adam and others, still, if the growth of the earth be an acknowledged fact, it follows that, upon the foregoing basis of the year’s duration, Adam lived about 93 of our years, or rather above the average age of old men of the present day. Or, if we consider that even during Adam’s life the years may have increased in length very rapidly, and that we may take forty days as the average, he would then have died at the age of about 103 years. We might yet venture further, and say that, even according to cases now on record, Adam lived 130 of our years ; then the year, or which would be the same thing, the earth’s revolution, would have been performed in seventy days, or in about one-fifth of our year. This, perhaps, was nearer the truth at that time, for we find, in the next verse : “And Seth lived an hundred and five years, and begat Enos.” Seth would then have been twenty-one, according to our years. It would appear, from the first ten chapters of Genesis, that, during the period of

time which elapsed between the first creation of man and the flood, the earth very slowly extended its orbit, for we find that the ages of the men did not decrease rapidly.

After the flood, it is probable that the earth might be in a more fit state to be moved further from the sun, for we find that water usually produces an atmosphere when acted upon by the sun's rays, for oxygen is then evolved, and this being a great component of our air, the change of orbits might, as a natural result, have followed the deluge. For, after the flood, we find that Arphaxad lived four hundred and thirty-eight years, and Peleg lived two hundred and thirty-nine years, and Nahor lived one hundred and forty-eight years, whilst Terah lived two hundred and five years. The year might then have been of either sixty or a hundred days in length, and nothing extraordinary as regards age has to be noticed.

But it may be remarked as at least curious, that so much is said with regard to the *ages* of the patriarchs who have been mentioned, for there appears to be not one word in Scripture from which we may not gather a truth, provided that we approach the subject

with a proper spirit. Again, in the twenty-fifth chapter of the same book, it is particularly pointed out to us that "Abraham ~~was~~ an old man, and *full of years*," and yet all the days of his life were only one hundred and seventy-five years, whilst Arphaxad lived more than double as many years, and yet no reference was made to his great age. Would this remark have been inserted if the years were of the same duration? Let it be granted, that during these periods the earth assumed to itself, and rapidly, too, a larger orbit, and this apparent mystery vanishes. And the earth would then have taken an orbit of nearly three hundred days, at the period of Abraham's death.

There are persons of such a sceptical nature that they will believe nothing but what they can see, hear, or touch. It requires more than evidence to prove a fact to such minds; and when they are possessed of a small amount of scientific knowledge, they usually turn it to a critical purpose, which shows itself too frequently in quibbles against Bible evidence. There are not wanting instances to demonstrate that there are *apparent* inconsistent remarks in the books of the

different Apostles; but from this, to conclude that the statements are untrue, is certainly somewhat bold, to say nothing of the lamentable lack of faith implied in such doubt. We will select two passages, which have been frequently quoted by sceptics as a proof of the want of consistency in the Bible.

The sixth chapter of Genesis states, that man's days *shall* be one hundred and twenty years. In the ninetieth Psalm, it is stated that his days *are* three-score years and ten, or fourscore years. "How can you reconcile these two statements?" asks the sceptic. Let us try what the rule of three will do to assist us.

If the year be 365 days long, and a man lives 80 years, how long ought the year to be if he lived 120 years?—Answer : $243\frac{1}{2}$ days.

Venus, the next planet to us, and whose orbit is inside ours, performs her sidereal revolution in 224 days; and we might have been a little larger than Venus, and perhaps half-way between where we now are and where she now is, when man's days were one hundred and twenty years. If we allow that the earth be

* The Tropics of Venus extend to within 15° of her poles. (See page 31.)

growing, and its orbit extending, most of the alleged inconsistency of Bible evidence at once disappears; and, if the earth's increase become a recognised fact, these same sceptics will probably think that something more than they now know may be discovered if they search the Scriptures.

CHAPTER V.

ASTRONOMICAL FACTS—PAST AND PRESENT.

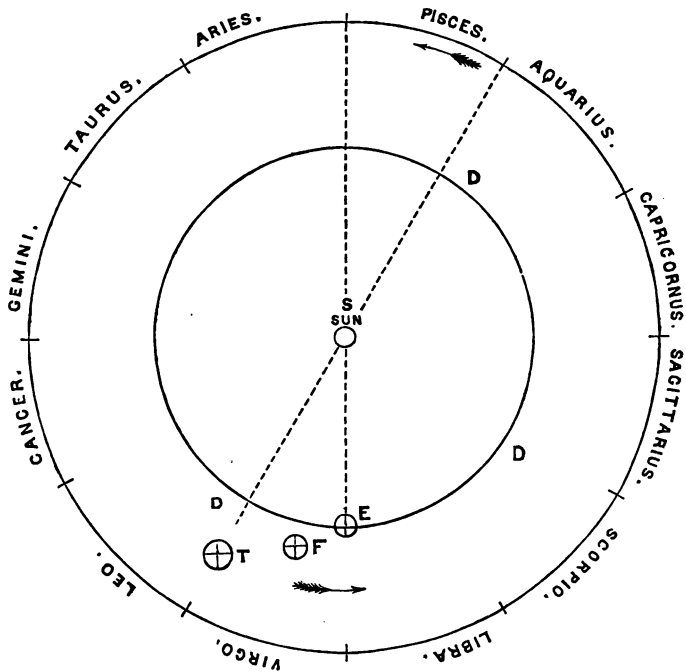
It is not opposed to reason to assume, that as the earth increased in size, and as its orbit also increased, the effects would be more apparent when the earth was small, than at the present time, by presenting themselves in a higher ratio ; for the increase of, say 50,000 miles in a small orbital circle of merely sixty millions of miles in diameter, would cause a great difference in the periods of the seasons, &c., whilst the same increase, in a circle of 180,000,000 of miles, would be perceptible only by means of good instruments.

A very natural question may here be put, viz. That some changes must have been remarked had the earth's orbit enlarged ; and the records of certain ancient phenomena being examined, the period of occurrence must surely differ from ours at the

present time. In answer we can say, that every ancient record *does* show this difference, and does clearly demonstrate that the earth's orbit is enlarging, but that men appear hitherto to have been strangely blind to the fact.

We desire to make no statement that rests upon assertion merely, for evidence, to have any weight, ought to be most severely tested; the annexed figure, therefore, and the following description, are submitted in proof of our views. Let S be the position of the Sun; E that of the Earth; then the Sun will be at the first point of Aries. Now if the Earth revolve in the smaller orbit, it will, on the same day of the next year, be again at E, and the Sun will also be in the first point of Aries; but if the orbit become enlarged to D D D, the Earth will have moved in a spiral, and, after having passed over the same distance in space, will fall short of E, and will merely have arrived at the point F for instance. Each successive revolution would cause the Earth to fall shorter of F. If the orbit still increased, a point T would be the point reached by the Earth on the same day of a year, distant,

perhaps, 1000 years from that on which the Earth was at E. The Sun, therefore, on this same day would appear in the constellation Pisces, instead of in Aries. Now suppose this day to be called



the 21st March, we may then see clearly the cause of that effect which is known to science as the Precession of the Equinoxes, and to account for which

effect, more controversy, argument, and theories, have been expended, than upon, perhaps, any other subject since science was known. If the fact of the earth's growth be rejected by the learned, still, this cause of the Precession of the Equinoxes might be of use to the inexperienced astronomer or amateur. If it be considered merely as a vague assertion, still, a circle and a small scale are all the scientific aids required to measure the effect of this Precession ; and, as simplicity must be a very desirable circumstance for beginners to arrive at, it follows that the theory might, at least, tend to avoid confusion, although opposed to the laws laid down by the past generation of scientific astronomers.

Theories are merely valuable according as they show cause for known effects, and each proposer of a theory values his ideas as does the poet the productions of his imagination. But again, a question suggests itself ; for if the Earth does not reach to the point E the same day, after many years there will be a difference of at least several days in the year. Now, considering that a circle has 360° , and that the Earth passes, it is said,

through these, in round numbers, in 365 days ; it would, therefore, occupy the Earth 12 days to pass over one sign, or 30° . Supposing this to be the case, there would then be 12 days too much in the course of many years.

This is very nearly the difference which Pope Gregory found in 1582; for the vernal equinox, which in 325, at the council of Nice, fell on the 21st March, fell in 1582 on the 11th March ; therefore, during this period the orbit had increased in circumference a ten days journey for the earth.

To prevent such matters from again occurring, it was ordained that in every succeeding cycle of four hundred years, three of the leap years should be common years. This correction was introduced into England in 1751, when it had become necessary to omit eleven days of the current year. So that as matters are now arranged, the increase of the earth's orbit will be carefully concealed, and summer will not in 2858 take place in December, nor winter in June, which would very nearly have happened if this alteration had not been established ; but there was still another change to be made, or even an individual

of common observation would have discovered the fact of the growth of the earth—and the increase of orbit.

Each star comes punctually to the same meridian at an interval of 23 hours 56 minutes 4·09 seconds of mean time. If, therefore, the earth's orbit increased, the star would show two variations as to the times, and two as to the declination. But as these pages are for the perusal of the popular mind, the scientific portion has been put as simply as possible.

Therefore, the detail of these changes in the right ascension and declination will not here be given, as the subject to be comprehended requires that the reader should be acquainted not only with geometry and trigonometrical surveying, but also with astronomy. One object of this book is to avoid mystification, therefore those subjects which to be understood require a somewhat deep knowledge of science, have been omitted, although probably by so doing we may have lost an opportunity of being considered profound.

We will, however, make one remark which bears upon the change in right ascension of the stars.

When it is stated that our days and years are not

longer than they were formerly, an assertion of the greatest boldness is at once put forward, and the same conclusion is jumped at, as was shown to be the practice with the measurement of base lines, viz., that former records and measurements were altogether wrong, and only those of the present day correct. To measure time a *standard* is necessary, and if this standard vary, we are perfectly unable to compare past and present time. We may say that 60 seconds = 1 minute; 60 minutes = 1 hour; 24 hours = 1 day, and 365 days, a few hours and minutes = 1 year; but we know not what a day or hour or year is, unless we have a standard.

Our clocks vary, they will not serve for a standard; but we must resort to the passage of the Sun and of the Stars across our meridian, and if these gradually come more slowly or quicker each day, we could not discover the change, but would consider that the clock itself was varying, because the stars may be called the standard. Upon examining the axial rotation of the distant planets, we find that their day must be very much shorter than ours, whilst their year is much longer. Now supposing that our day were

decreasing in length, how could we discover the fact? Our only standards, the stars, would become altered in their real time of transit, and all our chronometers would be regulated to suit this change, and the problem would be one most difficult of solution.

But this increase of the earth and its orbit may be but one of the vast changes which are going on in creation; the other planets would probably share in the growth, and if our rotation became more rapid, so ought theirs. Now the planet which is usually considered to bear the greatest analogy to the earth is Mars, and upon reference we find, that in 1666, J. D. Cassini, with a thirty six foot telescope, concluded that Mars performed his rotation in 24h. 40min. 0sec. a result which was afterwards confirmed by his nephew, Maraldi. In 1779, Sir W. Herschel concludes that the rotation cannot be less than 24h. 39min. 5sec., nor more than 24h. 39min. 23sec., and the latest authorities (Beer and Mädler, *Astr. Nacht.*) give 24h. 37min. 23sec., as the period of rotation. We have here, then, two courses open to us; first to sneer at the former observers, and conclude that

they erred in their observations, in the same manner as former astronomer-royals, surveyors, &c., and secondly to believe that Mars is actually rotating more quickly. The choice of conclusions is left to the reader.

CHAPTER VI.

ASTRONOMICAL OBSERVATIONS, PAST AND PRESENT.

WHEN the astronomers of former years first arranged a system, they naturally considered as the sun rose in the east, and passed to the south, and set in the west, and the moon, stars and planets all travelled through the sky, that the earth stood still, whilst every other orb revolved around it. The difficulty of convincing the sages that the earth revolved around the sun, was perhaps greater than can now be conceived, unless we consider that motion is always puzzling, provided it be gentle. A ship leaving the shore, a railway train when starting, &c., all tend at first to lead an observer to attribute the motion to other objects than that on which he stands, therefore to attribute motion to the sun rather than to the earth was very natural.

Now again, as the earth increased in growth, and

its orbit increased, (supposing for a moment that the fact be granted,) the stars would appear to change their position, and to attribute this change to the earth, would be, and has proved to be, the last thought of man. Therefore the stars were said to move, but when year after year, more declination was given to some, and less to others, and it was found in spite of this, that the stars neither became crowded around the North Pole, nor separated at the Equator, these were then said to *appear* to move.

In a former page it was stated, that the growth of the earth, and the increase of its orbit, could not be so very easily discovered by means of the latitude and longitude, because the earth, considered as a sphere, contains 360° ., and as there exists amongst all astronomers what is called "personal error of observation," and this personal error is sometimes as much as three-tenths of a second, and varies with the state of health of the observer, it follows that accuracy to the amount of a hundredth part of a second cannot *always* be attained.

The method of finding the latitude in an observatory is usually as follows. The instrument is placed

truly vertical, and the reflection of the cross hairs is made to coincide in a trough of mercury with the hairs seen by direct vision; thus the zenith of the place of observation may be correctly ascertained, and the altitude of a star or planet at once obtained. When corrections are made for refraction, collimation &c., the zenith distance is added to, or taken from the declination, according as the star is south or north of the observer.

In almost all observations in the northern hemisphere, it is customary to observe stars to the south, or as it is called, the "Upper Transit." At Greenwich particularly so, because the lower transit being towards Blackwall, is usually foggy or thick. Now, if the earth and its orbit increased, all the stars to the south, and having north declination, would appear to fall nearer to the equator, and stars having south declination, being somewhat near to the horizon to an observer in England, it consequently follows, that owing to refraction, &c., south stars are not in this country so much depended upon as those which are nearer the Zenith. When stars appear to approach the equator, their declination appears to decrease, although

they actually remain in the same spot in the heavens ; therefore, to carry out practically the theories of forty years ago, these stars have been said, according to all authorities, to have decreased their declinations during many years. Now as the latitude is found as follows :—

$$\text{Latitude} = Z.D. + Dec.$$

and this equation has been so amalgamated with colatitude, North Polar Distance, &c., as to be to all purposes tied to them, it follows that if a star is accused of having less declination, the latitude taken by that star will consequently be less, and if 2000 stars are accused of having less declination than in former years, the place of observation, will also be accused of having less latitude, and here follows—

Greenwich observatory.

Latitude.

By Professor Bradley, 1796 . . .	51° 28' 41".5
Maskelyne	51° 28' 40".7
Pond	51° 28' 38".5
Airy	51° 28' 38".3

Or during 64 years, the latitude has decreased 3".2, a result which in practice is somewhat diffi-

cult, unless we allow that the earth has grown, or that the decrease in declination of the stars has been apparent and not real. The conclusion which has been arrived at is, of course, as before, namely, that the former astronomers were very incorrect. Surely there is less heresy in saying that a fact has hitherto escaped our observations, than in stating that such men as Bradley and Maskelyne could have erred to the amount of 3" in their observations.

It is not to be wondered at that astronomers have never thought of the possibility of the growth of the Earth; the discovery (if so it be) was more in the province of the surveyor, and even he had but little chance unless he were provided with ample and accurate instruments, and practised in astronomical observations. That this fact has been suspected we have no reason to doubt, for there are some remarks in a French work now before us, in which, when speaking of base line measurements, and of the discordance between present and past distances, the author says, "If their measurements were correct, then something wonderful follows."

But to return to the latitude. When we examine

past and present records, it is really quite alarming to find what an effect has been produced upon various observatories by the *apparent* motion of the stars. Nearly every observatory in England has shifted its position several hundred feet. Here are the official records :—

Nautical Almanack, 1845 and 1858.

	1845.		1858.
Durham . .	54° 46' 14".9	—	54° 46' 6".2
	Moved 8".7, or about 290 yards.		
Oxford . . .	51° 45' 40"	—	51° 45' 36"
	Moved 4," or about 133 yards.		
Kensington .	51° 30' 12".7	—	51° 30' 11".6

Only moved about 110 feet.

Also, the latitudes given in 1827, by Francis Baily, Esq., F.R.S., President of the Astronomical Society, and the same shown by the present records :—

Observatory, Edinburgh.

1827.		1858.
55° 56' 42"		55° 57' 23".2
Moved 41".2, or about 1373 yards.		

Observatory, Cambridge.

1827.		1858.
52° 12' 43"		52° 12' 51".8
Moved 8".8, or nearly 300 yards.		

Some of the continental observatories think nothing of a skip of a few hundred yards:

	1845.		1858.
Berlin . . .	52° 31' 13".5		52° 30' 16".7

or simply a move of 5680 feet—about a mile and a hundred yards.

Whether the real position of the observatory has moved we know not.

The observatory of Christiania has travelled north, and has moved 36", or 3600 feet, during the last twelve years. We often hear of observers complaining of their instruments being tremulous, and such a circumstance is not surprising, considering how even they allow that their observatories are moving about.

Now, although the assertion may savour of presumption, it must, nevertheless, be stated that the increase in the size of the earth, and in its orbit, must necessarily cause the declination of stars, as at present given, to be slightly in error; consequently, we ought to find some great discrepancies in the latitudes of different places, when compared with the actual measurements.

Endless examples of such a nature are not wanting, and the errors appear to have caused no small amount of confusion amongst those whose personal accuracy was above even suspicion.

In 1801, a zenith sector, with a telescope eight feet long, and with a graduated arc of 15° in extent, was the instrument used to determine the latitude between different stations; and, as the earth was said to be an ellipsoid, it followed that the measured length of a degree ought to increase with the latitude. The following somewhat strange conclusions were arrived at:—

	Latitude.	Length of Degree in fathoms.
Middle point between Arbury	° ' "	
Hill and Clifton	52 50 30	. 60·766
Middle point between Dunnose		
and Clifton	52 2 20	, 60·820
Middle point between Arbury		
Hill and Dunnose	51 35 18	. 60·864
Middle point between Dunnose		
and Greenwich	51 2 54	. 60·884
It is stated that General Mudge did not deduce		

from these unexpected results that the earth was an irregular solid, and still less did he deduce from them any argument against the Newtonian theory. But he explained them as the *effects of deflections of the plumb line of the sector*.

The difference between the latitudes of the observatories of Pisa and Florence, which so much disturbed Inghirami, was as follows:—

By geodesical measurements from Flo-

rence, the latitude of Pisa was found

to be $43^{\circ} 43' 19''.4$

By astronomical observation of 504

stars $43^{\circ} 43' 11''.7$

Or $7''.6$ less by the stars than by actual measurements, a result which would probably follow if the declination of the stars was less than it ought to be.

The latitude of Unst was determined by Biot to be $60^{\circ} 45' 25''$; the latitude of Balta, by the great sector, was found to be $60^{\circ} 41' 1''.6$. The geodetic difference between the two stations is $26''.9$, which being added to the latitude of Balta, gives $60^{\circ} 45' 28''.5$, or $3''.5$ more than that determined by observations; a result

which would also follow if the declination of the stars was not what it ought to be.

But it does not necessarily follow that the measured distances should always be found to give greater difference of latitudes than the observed. The discordance would appear to depend more upon the position of the stars which are observed, whether those stars be north or south of the observer, north or south of the zenith of Greenwich, and have north or south declination.

It certainly appears curious that, according to the very best geodetic measurements, it was necessary to assume errors in France of $3''.1$, $5''.8$, $0''.8$, $3''.6$, in the latitudes of Dunkirk, Evaux, Carcassone, and Mountjoy, in order to reconcile results to prove the spheroidal figure of the earth; and in England it was necessary to suppose an error of $8''$, observation tending to demonstrate an equatorial rather than a Polar flattening.* And be it remembered, that the *cause* of the precession of the equinoxes, the precession and nutation of the stars, and other strange facts, is said to be due

* Professional Papers of the Corps of Royal Engineers, vol. iii. New Series, page 22.

to "a power lodged in the sun and the moon, which power acts upon the *protuberant mass* of the earth's equator, and plunges successive halves of the equator below the ecliptic." What becomes of this theory, if observation tends to show that the protuberance may possibly not exist? The French remark as follows :*

MM. Picard, De la Hère, et Cassini, à l'occasion de la Méridienne, tracée dans toute l'étendue de la France, trouvèrent la diminution du Degré, en avançant vers le Nord, et son augmentation en allant vers l'Equateur. Delà, ils conclurent que la terre n'étoit pas parfaitement ronde, et que bien loin d'être un Globe parfait, elle devoit être applatie sous l'Equateur, et allongée vers les Pôles. La conclusion étoit juste, en supposant la justesse de l'observation, parceque la Courbure de la Terre, augmentant vers les Pôles, devoit être allongée, et la Courbure de la Terre, diminuant sous l'Equateur, devoit être applatie.

La nécessité de s'assurer de plus en plus de cette découverte, et les avantages qu'on crût pouvoir en

* "Globe Terrestre," par une Société de gens de lettres.

retirer par rapport à la navigation, déterminèrent le Gouvernement, au commencement de ce Siècle, à ne rien épargner pour acquérir cette connoissance.

Des six opérations de M. Cassini, faites en 1701, 1713, 1718, 1733, 1734, et 1736, il en résulte les inégalités des degrés, en allant Nord et Sud, et Sud et Nord, et la diminution des degrés, en allant de l'Est à l'Ouest, ou de l'Ouest à l'Est, et par conséquent l'allongement de la Terre. Ils ont pour cela mesuré 8 degrés de latitude, et 6 degrés de longitude ; et ont conclû que la Terre étoit un ellipsoïde, dont le plus grand Axe va d'un Pôle à l'autre, et le petit est le diamètre de l'Equateur. Le grande Axe est de 6579368 toises, le Petit de 6510796 toises, et le rapport de ces deux Axes comme 96 à 95.

Ces opérations ayant été faites avec précision, auroient décidé la question, si ces mesures n'avoient pas paru contraires aux loix de l'Hydrostatique. C'est ce qui détermina le Roi en 1736, à envoyer un nombre d'Académiciens vers l'Equateur et vers le Pôle, pour prendre des mesures qu'on regardoit comme plus décisifs que celles qui avoient été prises en France

par M. Cassini. Suivant les observations faites au Nord par MM. De Maupertius, Clairaut, &c., l'axe de la terre ne s'est trouve que de 6525600 toises, et le diamètre de l'équateur de 6562480 toises, et le rapport de l'axe de la terre au diamètre de l'équateur de 177 à 178, on a mesuré pour cela une distance de 55213 $\frac{1}{2}$ toises, depuis Tornea jusqu'à Kiltis, à laquelle répondoit un arc céleste de 57 minutes et 27 secondes. Les observations faites à l'équateur par MM. de la Coudamine, Bouguer &c. sont conformes à celles du Nord. On a trouvé que le degré mesuré en France devoit avoir la même valeur que celle qui avoit été assigné par les résultats des operations faites au Nord ; mais on a conclu le rapport des deux axes de 214 à 215. On a pour celà mesuré une bāse de 6272 toises, qui servoit de premier à la suite 32 triangles principaux et les 176950 toises, qu'on a mesurées, répondoient à un arc du ciel de 3 degrés, 7 minutes, et une seconde.

Ainsi, suivant les mesures prises tant à Quitto qu'à Tornea, les degrés du Méridien étant plus petits à l'Equateur, et plus grands aux Pôles, on doit conclure que la Terre est aplatie dans la direction du Nord, et qu'elle ressemble à un ellipsoïde, qui a une

moindre courbure vers les Pôles ; mais il n'appartient qu'au tems de décider de l'uniformité et de la quantité de cette courbure. D'ailleurs, comment déterminer la somme de l'applatissage de la Terre, à cause des inégalités répandus sur le Globe. Les Astronomes, et les Physiciens sont aujourd'hui partagés. Les uns, comme MM. Childrey, Burnet, Eisenschmid, Mairau, &c. soutiennent l'allongement de la Terre par différentes raisons Physiques et Mécaniques. Les autres, comme MM. Huygens, Newton, Gregori, Herman, &c. décident en faveur de l'applatissage, mais en attendant la décision finale de cette fameuse contestation, la Terre demeurera en possession de sa sphéricité. On peut la supposer telle, sans aucune erreur sensible, parceque la différence du grand et du petit axe n'est que d'environ une 95^e partie suivant M. Cassini, que d'une 178^e partie suivant M. de Maupertius, et enfin que d'une 215^e partie suivant M. de la Condamine.

Many other strange circumstances might be quoted, which show that measured distances will not agree as they ought with astronomical observations ; and, in spite of the assertion that the present race of astro-

nomers know everything, it is evident that anomalies and contradictions of the most serious character are in existence and remain unexplained. When we observe, in the official "Ephemeris," that the positions of stars, planets, sun, and moon, are given to the one-thousandth part of a second, and when we also remark that the lengths of base lines are known to the one-hundredth part of a foot, it does appear curious that, when the two departments come to be compared, discrepancies of four or five seconds, and of four or five hundred feet, are found not only to exist, but to remain without any satisfactory explanation. Let it but be granted that the earth is growing and its orbit increasing, and nearly every such mystery, which has puzzled the learned for a thousand years, at once vanishes.

CHAPTER VII.

A PRACTICAL METHOD TO PROVE OR DISPROVE THE GROWTH OF THE EARTH.

A METHOD by which to discover the growth of the earth, and which would avoid a chance of errors of observation, would be to procure a non-elastic measuring chain, of about 100 miles in length, fasten the ends firmly from shore to shore of two continents, or upon two stations in land. If the earth were increasing in size, a few years growth would surely cause the chain to snap in twain. But would even this decide the question? Would not individuals rather conclude that the chain itself had shrunk, or that atmospheric phenomena had produced the result, rather than that the earth had expanded, or would they not attribute the fracture to some more wild or untenable cause, which, although unsupported by any sound evidence, would still be considered satisfactory?

If the reader doubts that such a conclusion would be arrived at, and think that the fracture of the chain would at once decide the question, we must beg to differ from him; for that which has been stated as a practical method *to be* adopted, has in reality *been* adopted for many years; the fractures have taken place some scores of times, but no reason has been assigned for these, other than *accident*.

It must now be stated how these measuring chains were fastened, how they broke, and the evidence which has been gathered with regard to them. In the first place, the measuring chains are Submarine Telegraph Cables, laid between England and various parts of the Continent fastened at each end, and having what is called a certain amount of slack paid out. Some of these cables exceed one hundred miles in length, and there are very few of them which have escaped being torn asunder after they have been submerged for a short period. From information with which we were favored by one of the principal officials of the Telegraph, in answer to an enquiry which we made upon the subject, it appears, that suddenly the telegraph ceases to work; and upon electric

tests being used, it is discovered that either the gigantic iron cable has actually been rent asunder, or the interior copper wire only has been broken. The fracture looks usually as though the cable had been pulled apart by enormous force. The usual cause assigned was a ship's anchor, but this cause was called upon to explain the fact, because *no other possible reason could be assigned*. It appears, however, an unaccountable circumstance that a ship's anchor should always break a cable when it fouls it; whilst the same cable can be hauled up and repaired without being fractured by the proceeding. The two cases appear somewhat similar, and yet the results are widely different.

It was acknowledged that the fractures did not present the appearance of having been effected by a blow of a hatchet or of any other sharp instrument, but that they looked really as though a great strain had acted upon the cable.

We were permitted to examine one of these fractures. The iron coating was torn asunder, the ends of the iron wires appearing as though attenuated. There was not a sign of the cable having been cut, and as though to contradict even an assertion of this des-

cription, the interior or copper wire was not torn asunder at exactly the same place as was the iron coating, but had been drawn about ten inches out of its gutta percha coverings. At least a couple of dozen similar fractures were to be seen in the Electric Telegraph Company's establishment.

Here then had been the very experiment already tried; the chains had broken scores of times, but the fact of the growth of the earth had not even been suspected.

From a close examination of the records of base lines and other measurements, and also from geological formations, a conclusion was arrived at that the gradual increase of the earth was not uniform. Some parts increase rapidly at certain periods, others very slowly—the nature of the soil is one of the conditions concerned. A hard or rocky foundation would increase with less rapidity than would a softer soil, and, consequently, we should expect that that part of the earth which is covered by the sea would grow more quickly than would the dry land. And even the bottom of the sea varies. A rocky portion in one part, and a muddy portion in another,

would not increase in the like ratio, and, consequently, a cable which happened, by accident, to have a great amount of slack paid out over a growing neighbourhood, might, even after portions of it became firmly imbedded in the soil, be enabled to extend itself so that it avoided fracture. But if a portion in which there was no slack became imbedded, and the earth at that part expanded, packthread would scarcely snap more quickly than would a non-elastic wire chain. Thus one or two of the submarine wires have been found to last without breakage for many years, whilst others are rent asunder a few weeks after they are submerged—but only about 10 per cent. have escaped. But, sooner or later, every wire must and will be torn apart, if allowance be not made for this gradual or partial increase. A perfectly elastic cable would, therefore, be the only protection against so powerful an enemy to the present continuous international telegraphic communication. As a rule, the longer the wire, the greater the chance of a rapid fracture.

It will be evident from the foregoing remarks, that if England and America, England and Hol-

land, Africa and South America, were separating from each other at the rate of even a mile per annum, the fact could not possibly be discovered, except by the fracture or attenuation of the iron chains which connected the two continents. The increase in the length of voyage of ships would be so trifling as to escape notice; the latitude and longitude (the only method of finding distances) would be the same in both cases, on account of the earth being a sphere. Therefore, strange and wild as the assertion may appear, still it is nevertheless a fact, that Africa and America might even be extending their distances two or three miles per annum; and, if the Earth's revolution as gradually increased, neither by astronomy, surveying, nor any other science, could we, by any possibility, discover the fact.

CHAPTER VIII.

ANCIENT AND MODERN SYSTEM OF REASONING UPON NEW SUGGESTIONS.

THE history of the past tends to show a very curious phase of the human mind. It would appear that man has ever struggled hard to prove two fallacies. First, that he and his planet were the centre of all creation ; and, secondly, that he had, by the gigantic power of his intellect, discovered everything worth knowing.

It is difficult, when we read the history of our forefathers, to avoid a smile when we see such arguments as the following urged against the existence of more than seven planets : “There are seven windows given to animals in the domicile of the head, through which the air is admitted to the tabernacle of the body, to enlighten, to warm, and to nourish it ; which windows are the principal

parts of the microcosm or little world—two nostrils, two eyes, two ears, and one mouth. So in the heavens, as in a microcosm, or great world, there are two favorable stars, Jupiter and Venus; two unpropitious, Mars and Saturn; two luminaries, the Sun and Moon; and Mercury alone undecided and indifferent. From which, and from many other phenomena of nature, such as the seven metals, &c., which it were tedious to enumerate, we gather, that the number of planets is necessarily seven. Moreover, the satellites are invisible to the naked eye, and therefore can exercise no influence over the earth, and therefore would be useless, and therefore do not exist. Besides, as well the Jews and other ancient nations, as modern Europeans, have adopted the division of the week into seven days, and have named them from the seven planets. Now, if we increase the number of planets, this whole system falls to the ground.”

If, however, we merely smile at the little-mindedness of our forefathers, we are not likely to derive much benefit from the lesson. The great object of history ought to be to point out to us the errors to which men of all ages have been liable, and thus to avoid at least

these same errors, and then to endeavour so to discipline the mind, that the future may stand out as a bright example to those who are yet unborn ; but who will have cause either to thank or condemn the present generation. Within the last 40 years, more absurd arguments have been used against discoveries than even that of the learned astronomer Sizzi, whose words we have just quoted. Within the last few months much discussion has taken place with regard to the nature of cometary bodies. One party asserts that these bodies are so and so. Another, and a very learned party too, asserts that they cannot be, for such a theory is opposed to all the known laws of mechanics. If for mechanics, we substitute microcosm, the argument of Sizzi would appear to be risen again. Mechanics are usually divided into two parts, viz., statics and dynamics. The first deals with bodies without motion, the latter with bodies which have motion ; but these bodies must be of a certain nature, or they will not obey either the laws of the one or of the other.

If the assertion is made, that comets obey the laws of mechanics, the grand problem must be at once

solved, for the nature of these bodies must then be known ; for we cannot state that any body must obey a law, when we know not of what that body consists. Our forefathers would have ridiculed the idea of balloons ascending in the air, as opposed to every known law. What law of mechanics, we would ask, does that body obey, which rushes towards the sun, flies off, and does not return for a thousand years ? Is it the law of gravity, of centrifugal force, of affinity, of attraction, of repulsion, or does it obey some other law not yet known ? What law does the variation of the compass, and the dip of the needle obey ? What law does Jupiter obey when he has four satellites, and the earth but one ? We may talk very learnedly about laws, but, if we once forget that we are as yet but gathering pebbles on the sea shore, we shall be merely following the example of the ancients, who although ignorant when compared to us, still deluded themselves into the belief that they knew everything. Men who think this are but stumbling blocks to advancement. We should “ hope everything and believe nothing impossible.”

Having asserted our belief in the expansion of the

earth and the increase of its orbit, and this assertion being opposed to the ideas at present generally received, it becomes necessary to state what causes have been assigned for the facts with which the world is acquainted. Taking the earliest periods first, we will then advance to the present time.

The great age attained by the patriarchs is a fact either unexplained, or one which is considered a miracle, but no cause is assigned for these ages gradually decreasing from upwards of 900 years, to less than 200. If it be *necessary* that a miracle be claimed, then, of course, no other reason can be accepted, but if otherwise, the increase in the earth's orbit will explain both.

The next fact is the extraordinary amount of tropical plants, and tropical animals, the remains of which are found in northern regions, not only in England, but even as far north as Siberia. No cause is assigned for this; it is merely stated that the climate *must* have been warmer then than now. Diagram, page 30, will show a cause.

The variation of the ecliptic will be next treated of, and upon reference to the most able books on

astronomy, we find the *cause* stated to be as follows—
First quoting from Sir J. Herschel's "Outlines of
Astronomy," article 640 and 641 :—

(640.) "Meanwhile, there is no doubt that the plane of the ecliptic does actually vary by the actions of the planets. The amount of this variation is about 48" per century, and has long been recognised by astronomers, by an increase of the latitudes of all stars in certain situations, and their diminution in the opposite regions. Its effect is to bring the ecliptic by so much per annum nearer to coincidence with the equator; but, from what we have above seen, this diminution of the obliquity of the ecliptic will not go on beyond certain very moderate limits, after which (although in an immense period of ages, being a compound cycle resulting from the joint action of all the planets) it will again increase, and thus oscillate backwards and forwards about a mean position, the extent of its deviation to one side and the other being less than 1° 21'."

(641.) "One effect of this variation of the plane of the ecliptic—that which causes its nodes on a fixed plane to change—is mixed up with the precession of

the equinoxes, and undistinguishable from it except in theory. This last-mentioned phenomenon is, however, due to another cause, analogous, it is true, in a general point of view, to those above considered, but singularly modified by the circumstances under which it is produced."

In spite of these remarks, the *cause* appears still somewhat obscure. Another explanation is given in a book published by the Director of the Cincinnati Observatory. At page 101 is the following:—

"More than two thousand years passed away since a discovery was made, showing that the sun's path among the fixed stars was slowly changing; the point at which it crossed the equatorial line, and which for ages had been regarded as fixed, was finally detected to have a slow retrograde motion, producing the precession of the equinox, the explanation of which phenomenon is given in the following words: 'A power does seize the equator, and plunges successive halves of it beneath the plane of the ecliptic, thus causing the earth's axis to tilt over towards the portions successively submerged, until it finally sweeps entirely round, and comes to resume its first position.'

But do you demand what power seizes the earth's protuberant equator, and tilts it successively towards every point of the compass? I answer, that power is lodged in the sun and moon, and it is their combined action which works out these wonderful results. How wonderful the structure of the universe! How gigantic the power of the human intellect!"

From the latter remark we beg to differ, for the best amongst us are but poor little manikins, creeping about on one of the smallest globes in the solar system.

Without occupying more space than is necessary upon this branch of the question, we will merely mention that the apparent approach of some stars to the equator, and the recess of others, is also accounted for by either a nodding or a tilting of the earth. If the one fail, the other is called upon; but as neither of these motions agree with the observations of the present day, it will shortly be necessary to attribute a fifth motion to the earth, or past theories will have to fall to the ground. The earth's motions at present are said to be—a diurnal revolution, a movement along its orbit, a nodding, and a gyratory movement of its

pole, which forms an ellipse once in nineteen years. It has been already stated that the latest geodesic measurements do not agree as they ought with the spheroidal figure of the earth ; and as these theories rest entirely upon this protuberant mass, they may be said to have at least a rather unstable foundation. And the fact of the sun, on the 21st March, being now 30° distant from the position which it occupied in ancient times, still appears to require a more clear explanation. On reference to diagram, page 48, it may be seen how this change might be accounted for, if we would but allow the possibility of the growth of the earth and the increase of its orbit.

Without presuming to state that the earth has not been demonstrated, either by measurement or the experiments of the pendulum, to be a spheroid, still it may be remarked that results obtained by the most elaborate and scientific processes differ considerably. From experiments carried on at various parts of the earth, the time of rotation, as deduced by the pendulum, varies as follows:—

	Hours.	Min.	Sec.
Dublin	24	14	7
Aberdeen	23	48	49
Geneva	24	41	39
Bristol	23	53	2
New York	24	8	9*

There is here a difference of fifty-three minutes between two results—and not one is within two minutes of the correct time—a difference which ought to cause us to look at least with suspicion upon theories deduced from pendulum experiments. When we examine other conclusions drawn from the same source, such as the density of the earth, there also appears a vast discrepancy.

A practical man naturally looks for results, and is not so much interested in the steps by which these results are obtained, as he is in the conclusions themselves. Without, therefore, questioning the amount of skill and patience displayed by the operators, we will look merely to the fruits; and we find that the density of the Earth (a matter of the greatest importance, as regards physical astronomy) is thus stated:—

* Galbraith and Haughton's *Astronomy*.

Schehallien experiment, by Maskelyne, calculated
by Playfair = 4·71

Airy, from Pendulum in Horton Coal Pit = 6·56.

Or nearly in the proportion of 4 to 6. That is, the Earth is 4·7 times the weight of water, or 6·5 times; a result which, in the total weight of the Earth, would cause a difference of, perhaps, some hundred billion million thousands of tons.

The measurements which have been given—the pendulum experiments, and the theory about rotation—are the facts upon which the theory of the protuberant mass, and hence precession, &c., are built.

Experiments ought to be fairly weighed as evidence, and not discarded because they do not agree with theories. And yet it appears that when the pendulum showed an ellipsoid as the shape of the Earth, this single experiment was looked upon as very satisfactory; but, when an opposite result was obtained, the trial was either *unsatisfactory*, or local attraction was called upon to explain the matter, and the experiment was rejected.

When so many important facts hang for explana-

tion upon the protuberant mass at the Equator, it appears curious that it should be so tenaciously and sacredly adhered to, in spite of the shocks which it receives from discordant facts. That this protuberance does exist, is no doubt probable; but that it is sufficient to account for all the effects attributed to it, is at least questionable.

The other causes of a curious nature, such as the late measurements of base lines and of districts, showing always a greater length or area than the former, are either unaccounted for, or are attributed to that easiest of all causes, viz.—error of former observers. Each individual concludes that he alone is correct, all those who have gone before him must have been wrong.

The same conclusions are arrived at with regard to the latitude of different observations. The breakage of telegraph cables is still a mystery, in spite of ship's anchors being forced into the argument. An examination of the Ephemeris from 1823 until 1859 will show some very curious facts which are not explained—the variations in right ascension and declination of the sun on different days, such as the 21st June, 21st December

&c., scarcely tending to demonstrate that observation carries out present theories. If, however, any practical astronomer applies, even as a theory, the increase of the earth's orbit to the solution of known facts, he will soon discover that it is at least a very convenient and simple explanation. It not only clears up many mysteries in astronomy, but also in physical geography and geology, and in other sciences, and instead of having a dozen theories to explain a dozen effects, one cause suffices.

CHAPTER IX.

ADDITIONAL EVIDENCE, WITH REGARD TO VARIOUS MEASUREMENTS, ECLIPSES, PLANETS, &c.

THERE is no proceeding which requires a greater amount of moral courage than that of asserting, that one's own observations differ even slightly from those of the celebrated men who may have surveyed a country before us. Even an experienced surveyor would be cautious, lest he himself might be incorrect, and a young or inexperienced operator would probably *make* matters agree, provided there was no very great discrepancy. To obtain a history of every true result is therefore almost impossible, but still we cannot avoid remarking how continually little differences are made to fit in, and how completely they might be overlooked by the casual observer. General Roy, in his paper read to the Royal Society in 1790, states at page 69.

"This distance agrees *accurately* with the length of
 "the same side in the 20th triangle, as given by the
 "base measured (three years before) on Hounslow
 "Heath. Here, however, it is to be remarked, that
 "in order to produce this agreement, the angle at
 "Hollingborn Hill, between Fairlight Down and
 "Allington Knoll, has been made $48^{\circ} 56' 28''$ instead
 "of $48^{\circ} 56' 31\frac{1}{2}''$, being a difference of $3\frac{1}{2}''$, which
 "according to observations it should have been.
 "Had not this reduction been made, the distance
 "between Allington Knoll and Fairlight Down
 "would have been 106,924 feet, that is to say, $1\frac{1}{2}$
 "feet *longer*."

Again, at page 75, General Roy refers to a base
 measured by M. Cassini de Thury, on the strand
 near Dunkirk, which base was said to be 39801·7
 English feet. General Roy found this base to be
 39808·7 English feet, or seven feet longer; a result
 which he concluded was due to M. Cassini's rods
 having expanded. If, however, M. Cassini were de-
 serving of the name of a surveyor, he would have
 daily compared his rods with a standard, and also at
 the commencement and finish of his operations; pro-

ceedings which would at once have proved the expansion, had it existed.

Again, if we conclude that 69 miles, for instance, $= 1^\circ$, two places, A and B, distant from each other 69 miles, would consequently be 1° apart. But if we found that $69\frac{1}{4}$ miles $= 1^\circ$, then A and B would be separated by a distance less than 1° . General Roy states that "If the preceding determinations of the longitude of the several stations between Greenwich and Dunkirk are accurate, or nearly so, as founded immediately on the British observations, and ultimately combined with the result of the operations in latitude $43^\circ 32'$, it follows that all the longitudes of the great map of France, the labour of more than half a century, will be considerably affected thereby, in proportion to the distances of the places eastward or westward from the meridian of the royal observatory at Paris, respectively. He then proceeds to give a table, in which the longitude east or west of Paris is always too much, according to the old observations, and a correction of from $1''$ to $2''$ he conceives will be necessary to make observation coincide with measurement.

In a work published (1858), by the Corps of Royal Engineers, there is a reference made to the geodetical connection of Moudovi and Audrante. The French engineers, in their operations of 1809, find the length of an arc 126394·6 metres, 38 metres *greater* than Beccaria had found it.

By the examination of the records of the Babylonian eclipses, and of the Arabian astronomer's remarks, it appears that the moon's motion has been growing swifter and swifter from century to century. When this fact was first ascertained, considerable alarm was caused, if we are to believe the statements of astronomers, "It thus became manifest,* that to all appearance at least, the moon's mean motion was growing swifter and swifter from century to century; that it was approaching closer and still closer to the earth, and if no limit to this change was ever to be fixed, sooner or later, the final catastrophe must come, and the moon be precipitated on the body of the earth, and the system be destroyed." Here was a bright prospect for us poor mundane creatures to look forward to—2,000 odd miles of cold moon

* Orbs of Heaven.

to come down upon us during some bright night, and yet we are told, that this fact, should not "excite the apprehensions of the nervous."* It is all very well for these great astronomers to tell us not to be alarmed, and to assure us that they will take every care of us, and will maintain the discipline of the solar system. But as the state of our nerves depends very much upon the condition of our digestion, there are times when we cannot *calmly* contemplate even the probability of a falling moon.

When we find that the *cause* of this increase in the Moon's motion is said to be from "the joint action of *all the planets*, which causes the Earth's orbit to gradually lose its ellipticity, and that this orbit will, at the end of a vast period, become precisely circular,"† and when we remember certain dynamical laws which apply to spheres moving in ellipses, and also refer to other great authorities, who state that the *Sun*‡ is the cause of this change, we may at least be pardoned if we are somewhat nervous; and also, if we express some doubt as

* Smyth's Celestial Circle, page 122.

† Laplace's "Theory." ‡ Baily's Astronomical Tables.

to the fact of these individuals possessing a certain knowledge of the true cause of what is called *the Moon's acceleration of mean motion*. To allay in a measure our fears, we will examine Jupiter's Moons, and note how they are arranged; for as that planet has, it is said, four, whilst we have but one, the chance of a lunar catastrophe is greater there than on this earth. But taking the radius of Jupiter as unity, we find that one Moon is situated at a distance of only six times the radius, another only nine times, whilst our Moon is distant twenty-nine times our radius.

As long, therefore, as Jupiter's moons do not tumble upon him, we ought not to fear for ourselves.

When we hear learned men propounding theories with reference to the result of a collision between planets and comets, moons and earth, &c., the question naturally suggested is, whether these individuals believe that the Creator who formed the universe is even now watching over and regulating it, or whether they conclude that he left the worlds to take care of themselves. We are told that every hair of our head is numbered, and that not a

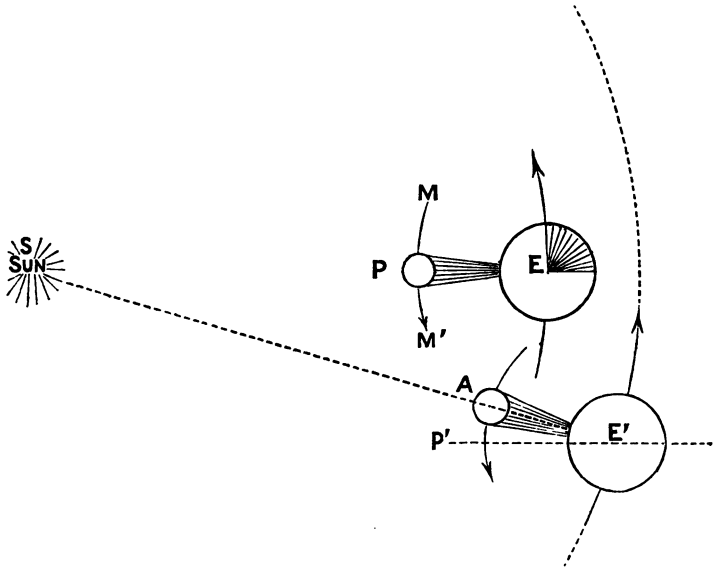
sparrow falleth to the ground without the knowledge of God. Surely, if we are so cared for, the Earth and the vast celestial spheres around us cannot be left entirely to those deities of science—centrifugal force, and gravity. If the philosophers acknowledge the supreme guidance, their speculations as to these collisions are so much time wasted; if they do not, then science is not worth much.

But let us note what effect would be produced by the increase in the size of the Earth's orbit.

* Let S be the Sun, E the Earth, P the Moon, during a solar eclipse. If the Earth and the Moon moved uniformly, the Moon will be in the same position after a certain number of revolutions. If the Earth's orbit become enlarged, the Earth, after the same lapse of time, will reach merely to the point E', whilst the Moon, during the same time, will have performed the same number of revolutions, and will have arrived at P'; but the eclipse will have taken place when the Moon was

* See next page.

at A, or before the former period. If it therefore



were concluded that the Earth had moved uniformly, then we should suppose that the Moon had moved more rapidly.

The assertion that the Moon is drawing nearer to us, and will at last fall upon us, is not carried out by observation; for Professor Baily gives the distance of the Moon = 29.982175 times the

Earth's equatorial diameter, or 237,526 miles, whilst more modern observations show 238,793 miles as the true distance.

When it was discovered that eclipses occurred formerly at different times, the conclusion was jumped at, that the Moon *must be* moving more quickly; consequently, according to centrifugal law, ought to be approaching nearer to the earth, and by and by would fall upon it. First, we trust from what we have seen with Jupiter's Moons, that the falling will not necessarily follow the approach, and, secondly, observation shows that a retrograde movement, rather than an approach, has been going on of late.

Enough, however, has already been said. If evidence is worth anything, the growth of the Earth ought to be an established fact.

When we first examined the records of past and present ages, and satisfied ourselves that the Earth and its orbit were increasing, we naturally concluded that we had discovered a somewhat singular fact; one which would solve the mysteries of many years. After nearly twelve months'

labour, however, we cannot but think that the increase of the Earth and *the universe* must be well known to the learned, who, however, have kept the secret to themselves. Below is a table, in which are the diameter of the various planets given in 1827, by Francis Baily, Esq., F.R.S., L.S., G.S., M.R.I.A., and President of the Astronomical Society of London. And the diameter of the same planets given in 1858, by Sir John F. W. Herschel, Bart., K.H., M.A., D.C.L., F.R.S.L. and E., Hon. M.R.I.A., F.R.A.S., F.G.S., M.C.U.P.S., &c., &c.

	1827, by Professor Baily. Miles.	1858, by Sir J. W. Herschel. Miles.
Mercury . . .	3140	3200
Venus . . .	7700	7800
Earth . . .	7924	7925.6
Mars . . .	4100	4100
Jupiter . . .	86,054	87,000
Saturn . . .	76,068	79,000

Two such reports, from such authorities, ought at once to decide the question.

The radii of the earth were stated by Francis Baily, Esq., F.R.S, President of the Astronomical Society, to be at or about 1827,

Equatorial radius = 20,919,360 feet

Polar radius = 20,850,720 „

In Airy's figure of the earth (1831)

The Equatorial radius = 20,923,713 feet

The Polar radius = 20,853,810 „

Thus showing a growth of 8,706 feet in the equatorial diameter, and 6,180 feet in the polar diameter, during this period.

In the magnificent work lately published (1858) upon the ordnance survey, and drawn up under the direction of Lt.-Col. James, R.E., F.R.S., are the following remarks.

“ In Airy's figures of the earth, the equatorial radius is 20,923,713 feet, and the polar radius is 20,853,810 feet ; but, from the ordnance and other more recent surveys abroad, the arcs are found to be 20,926,500 feet, and 20,855,400 feet.”

Since 1831, then, we have grown 5574 feet at the equatorial diameter, and 3180 feet at the polar diameter, or taking the circumference, we have grown

about 8 miles since 1827. And this is the result shown by the land measurements only, and if we could accurately measure the distance across the various seas and oceans, we should probably find that our growth had been even much greater.

We therefore conclude this part of our work by merely reminding the reader, that the earth is apparently growing, and its orbit increasing, two important facts which appear to have been forgotten.

CONCLUDING REMARKS.

It is not our present purpose to deduce any theories from the preceding evidence, other than that it appears that the earth is increasing in size, and is extending its orbit.

It would be a very easy matter to follow the usual steps of philosophers, and to draw up lengthy formulæ, by which to demonstrate that the solar system could not possibly last more than probably ten million billion thousand years. But as it is our belief that not only the earth, but the whole universe, is progressing under the guidance of the Supreme Being, who appears to have ordained that every particle of matter should not only be transmuted and thereby preserved, but should increase rather than decrease, we will, therefore, refrain from asserting that which the ten million odd years might prove to be false.

Judging, however, from the past, and from what our

telescope reveals of the size of other spheres, it would appear that the earth, if once the size of Mercury, will probably, in the course of time, attain to the size of some of the exterior planets.

When we note our own diminutive proportions, and then contemplate the vast dimensions of Jupiter and Saturn, it seems not opposed to any law, to conclude, that the small planets, such as Mars, the Earth, Venus, and Mercury might become larger, without becoming disproportioned to other members of the system.

It has been shown that there is some difficulty in obtaining the true density of our own earth, and we may therefore conclude that to obtain that of a distant planet is not a less troublesome operation. Still an approximation has been made to the various densities, and we find that the planet nearest the sun is the most dense in the solar system, whilst Jupiter and Saturn are much less dense than any others of which we have certain data. The increase in the size of the earth might not therefore entail an increase in its weight.* There are so many conditions here con-

* The amount of coal raised annually in Great Britain alone

cerned, that when we speak of certain results necessarily following certain changes, we talk somewhat at random.

To determine whether or not the growth be a fact, may be considered by the inexperienced a very simple matter, but this is not the case. If measurements are to be taken and compared with past measurements, just those steps will be employed which have been mentioned in the first chapter, and which do show an increase.

If astronomical observations are to be the tests, we have already the comparison of past and present records before us. If geology is to be called upon, we shall find the problem even more complicated, for geologists have long asserted that continents now separated, once joined each other.

There is at the present day a class of men who assume that every law of nature is known, and that every great fact has been discovered.

Let us look back during 2000 years, and we find the same type of mind common. From individuals is 62,000,000 tons. Theorists assert that this *cannot* cause the Earth to become lighter; they state as a *proof*, that if it did, *our orbit would be increasing.*

so constituted, it would be vain to expect any other notice than opposition, when a novelty is put forward.

The history of the past will, however, show us, nearly word for word, what will be said; for such minds are but stereotyped editions, one of the other.

The preceding pages, therefore, are intended merely for the perusal of those whose common sense is unwarped, and whose capacity of judging evidence is equal to that of the most profound philosopher. Among the general public, there is no scarcity of these qualities, and to them, therefore, as to a jury, the case is submitted, whether the evidence is sufficient to prove that the earth is growing, and its orbit extending, or whether we shall disclaim this expansion, and become, as we certainly must, the only self-asserted dwarf of the solar system.

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